To the Editor

Pape, Hans-Christoph

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We appreciate the concern about the distal tibial partial articular depression fracture (B3), but this was separate from the split depression group and did follow the original classification. The inclusion of sacral fractures below S2 in the pelvis section is for completeness. If a more detailed classification is required, the spine system may be used.

As a result of this revision process, the AO Foundation through its Media Production and Publishing section of the AO Education Institute has developed a system where changes to the classification can be made on the classification App and users of the App can be notified. The committee will definitely review the proposed changes and make these as need be.

James F. Kellam, MD
International Comprehensive Classification of Fractures and Dislocations Committee

To the Editor:

The authors provide an interesting description of parameters associated with an increased risk of systemic complications. Their view on the patient is different from previous report of the same group because they now focus on polytraumatized patients at the risk of multiple organ failure, sepsis, infection, and death. In the patients selected for this publication, approximately 50% have not normalized their trauma-induced coagulopathy[1] within 48 hours, despite treatment. Moreover, both, changes of coagulation and altered acid–base parameters are discussed. When compared with the results from other groups, treatment-associated changes of hemorrhage appear to be better controlled.[2]

This view in line with widely accepted concepts, according to which a triade of pathological changes contributes to complications.[3] In addition to these, inflammatory changes and specific injuries, such as those associated with severe soft tissue trauma[4] and chest injuries,[5] are known to be relevant risk factors, summarized as the 4 vicious cycles in polytrauma (Fig. 1).[6] Although Childs et al did not specifically document hypothermia, it is evident that both of their well-documented parameters—coagulopathy and acid–base changes—occurred most likely in association with a drop in body temperature. These may have added to their observed rate of complications, as a loss in body temperature affects both coagulation and acid–base changes.[7]

The authors focus on orthopaedic injuries and describe that those with early coagulopathy and acidosis present with a higher degree of abdominal injuries and truncal issues. One may conclude from this finding that patients documented and published by Orthopaedic Surgeons are similar to those documented by general surgeons. This is perfectly in line with our recent findings from a meta-analysis on pulmonary complications.[8] It is based on a comprehensive search of articles published in English and German language using PubMed, MEDLINE, and the ISI Web of Science. The study aimed to answer 3 main questions: (1) Has there been a change in the incidence of post-traumatic complications over the past decades? (2) Are any geographical influences discernible within Western societies? (3) Is the type of surgical service that publishes about these patients related to the rate of pulmonary complications? Interestingly, the results revealed no difference in any of the 3 aspects addressed in the questions. Moreover, there was no discernible difference in the incidence of pulmonary complications whether a publication came from an Orthopaedic or General Surgery background. We tried to explain this finding by assuming that subspecialties might be inclined to focus on the injuries they are mainly involved. Obviously, the patients involved in the publications most frequently had both orthopaedic and non-orthopaedic injuries that might have contributed to specifics of the clinical course.

Another interesting finding deals with the rate and distribution of complications. The current cohort seems to be significantly injured [mean injury severity score (ISS), 27 ± 12 points], and the complication rate matches that of a polytraumatized patient group, as described in several large databases. The types of complications and mortalities seems to discard the trimodal distribution of death, as some of their patient die as a result of severe head trauma and later death from systemic complications. This finding matches with several recent autopsy studies.[9] They no longer support the concept of a trimodal distribution of death. Instead, uni- and bimodal distributions of mortality have been reported in severely injured patients, with the main causes being head and chest trauma.[10]

Thus, the current article describes a population at an increased risk of developing systemic complications, such as sepsis, systemic inflammatory response syndrome, multiple organ dysfunction syndrome, and multiple organ failure. Multiple studies have addressed similar issues and report comparable results. To our knowledge, the largest group appears to be a study based on the National Trauma Data Base (3069 patients).[11]

More recently, an international consortium of experts from various field, including orthopaedic surgeons, general

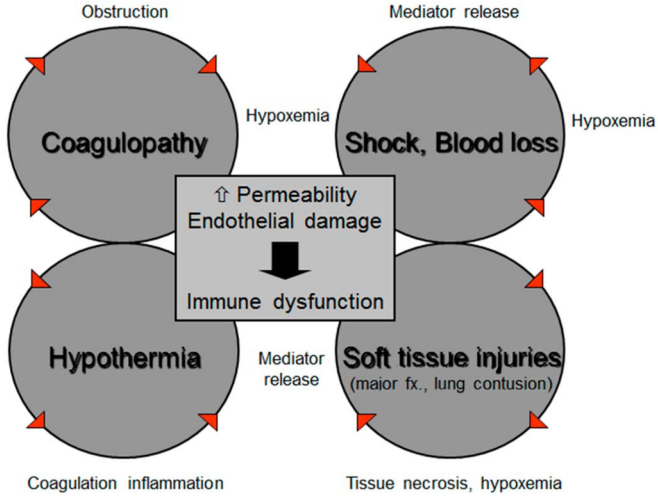

FIGURE 1. Description of the 4 vicious cycles leading to complications in polytrauma patients.

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TABLE 1. Berlin Definition of the Patient at Risk (Polytrauma)[9]

a. ISS ≥ 15 or greater
and any one of the following independent parameters
b.
1. Hypotension (systolic blood pressure ≤90 mm Hg),
2. Acidosis (base excess ≤−6.0),
3. Coagulopathy (international l normalized ratio ≥1.4/partial thromboplastin time ≥40 s),
4. Consciousness (Glasgow Coma Scale score of 8)
5. Age (≥70 y)

surgeons, and intensivists, has worked on an evidence-based definition of polytraumatized patients. In preparation of this work, Butcher and Balogh[12] reviewed 1665 publications that used the term "polytrauma," 47 of which included a definition of the term polytrauma. The group of experts involved in developing and utilizing the new definition used multiple databases, among them a Registry from New South Wales, Australia (4.935 patients),[13] a regional registry from a Level I trauma center in Europe[14] (375 patients), and a National Trauma Registry (28.211 patients).[15]

The initiative lead to a consensus process of 4-year duration, resulting in the "Berlin Definition of Polytrauma." The body of literature resulting in the "Berlin definition" found that the ISS is the basis for most of the assessments of trauma patients and "continues to be recommended by the American College of Surgeons" Committee of Trauma, The Trauma Outcome Research Network (great Britain), the German Trauma Registry, and the Australasian Trauma Society.[9] Likewise, the group involved in the Berlin definition describes that the sole use of ISS data is not enough to describe the patient at risk. In addition to the mere description of anatomical variables, their deductive calculations from 28.211 patients, all of whom required treatment in an intensive care unit during their hospital stay, provided evidence that additional parameters are required to describe the patient at risk. This was independent of whether orthopaedic or nonorthopaedic injuries were among prevailing diagnoses. Five independent physiological variables were identified, to cause an increase in the mortality rate from approximately 12% (ISS 16 or greater only) to approximately 30%. These parameters are listed in Table 1.

The results of this patient description was later assessed by independent groups of authors as follows:

Rau et al[16] used a Validation Test Based on Propensity-Score Matching Approach. They coin data from 201 selected propensity score–matched pairs of polytrauma and nonpolytrauma patients who showed no significant difference in sex, age, comorbidity, Abbreviated Injury Scale ≥3, and ISS. In their study, polytrauma patients demonstrated higher mortality rates (odds ratio, 17.5; 95% confidence interval, 4.21–72.76; $P < 0.001$), and a higher complication rate when the Berlin definition was used, that is, inclusion of several descriptive parameters including coagulopathy and acid–base changes.

Frenzel et al[14] tested 5 different scoring systems in a group of severely injured patients and used mortality as end point. They found that 2 scoring systems best described the patient at risk, among them the ones using the triade of death and other additional parameters. They support their findings by focusing on the annual report of the German Trauma Register DGU.[17] The official inclusion criteria of this database require patient's admission to the resuscitation room and a subsequent stay at the intensive care unit, resulting in 38,046 recorded patients in the year 2014. They discuss that "the exclusive use of an anatomical score ignores the physiological aspects of polytrauma, which are supposed to pose an extremely important additional factor in polytrauma rating" (Fig. 2).[10]

In summary, the article provided by Dr. Childs and coworkers supports the finding that multiple parameters are required to identify the polytraumatized patient at the risk of complications. More studies are required to identify the true distribution and changes.

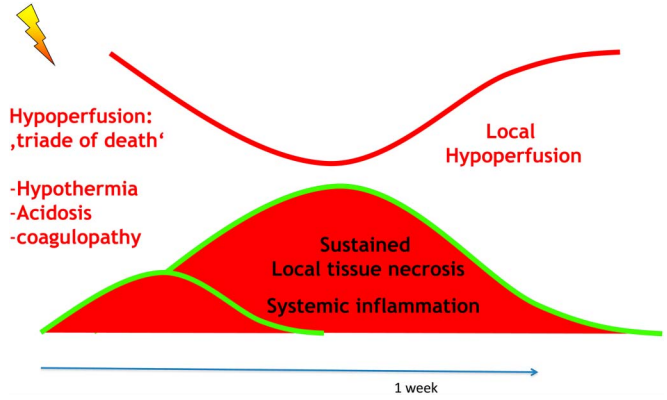

FIGURE 2. Soft tissue injuries: lung contusion.

Hans-Christoph Pape, MD, FACS
Department of Trauma,
University Hospital,
Zurich, Switzerland

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In response:

We would like to thank Dr. Pape for his interest in our recent article "Presentation Coagulopathy and Persistent Acidosis Predict Complications in Orthopaedic Trauma Patients." We appreciate being part of the conversation identifying patients with trauma at high risk of complications.

Dr. Pape points out the lack of consensus regarding the definition of "polytrauma" and describe the development of the "Berlin Definition" of polytrauma to identify patients at risk of complications. The Berlin definition requires an ISS $>$ 15 and 1 of the 5 following criteria: hypotension, acidosis, coagulopathy, GCS $<$ 9, and age 70 or greater. As Dr. Pape states, these 5 criteria were identified as independent predictors of mortality after regression for ISS.

We concur that these factors are all relevant in identifying patients at risk of complications. Our population all had ISS $>$ 15, with more complications associated with prolonged acidosis and presentation coagulopathy. Therefore, our conclusions support 2 of the 5 criteria in the Berlin definition. However, our study was not designed to provide an objective definition of polytrauma because many multiply-injured patients without musculoskeletal injury and with other orthopaedic injuries (excluding thoracolumbar spine, pelvis, and femur) were excluded from our study.

Should the definition of polytrauma be synonymous with increased mortality? The author cites Butcher et al,[1] who identified variations in the definitions of "polytrauma" used in the literature and the need for a consensus. They proposed defining "multitrauma" as injury to more than 1 body area that is less severe (AIS 2 or less) and "polytrauma" as more severe injury to at least 2 areas (AIS 3 or more). The inclusion criteria that we used for our study were ISS $>$ 15, high-energy fracture of the proximal or diaphyseal femur, pelvic ring, acetabulum and/or spine, and injury to another organ system.

If polytrauma is to be defined as patients who are at increased risk of complications and mortality, the Berlin criteria is a great start. It builds nicely off the anatomic nature of the ISS to include measures of physiologic burden. After all, the patient with polytrauma has physiologic burden greater than the sum of the injuries or even the sum of the squares of the 3 most severe injuries. Thank you for your interest in our article.

Benjamin R. Childs, BS*
Heather A. Vallier, MD†
Clyde L. Nash, MD†
*FAU Charles E. Schmidt College of Medicine,
Boca Raton, FL
†Department of Orthopaedic Surgery,
The MetroHealth System,
Case Western Reserve University,
Cleveland, OH

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